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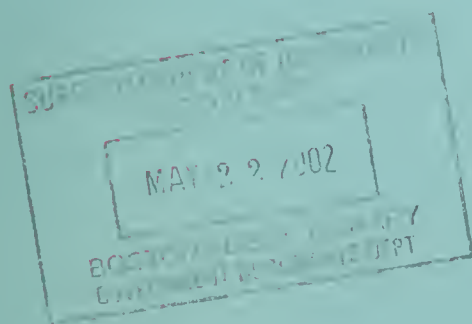
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TEST OF GRIT TYPES IN ALLEVIATING LEAD POISONING IN MALLARDS



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TEST OF GRIT TYPES IN ALLEVIATING LEAD POISONING IN MALLARDS

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ABSTRACT

Mallard ducks (Anas platyrhynchos) were given either 0, 2, or 4 No. 6 lead shot in combination with 4 grit treatments; no grit, coarse sand, mica granite, and crushed oystershell. Each combination was replicated three times. Ducks were maintained on a diet of whole corn. An analysis of variance indicated no significant differences in mortality in relation to grit type, but a significant difference (at 0.05 level) in mortality between the lead shot doses. Oystershell grit apparently reduced mortality of ducks dosed with 4 shot but not to a degree statistically significant. In all treatments, mortality was closely associated with shot retention. Ducks retaining shot for 2 weeks usually died.

TEST OF GRIT TYPES IN ALLEVIATING LEAD POISONING IN MALLARDS

For many years wildlife investigators and sportsmen alike have been concerned over the annual waterfowl mortality caused by lead poisoning. Wetmore (1919) and others focused on the fact that lead poisoning frequently occurred in wintering areas deficient in grit and suggested grit be added to such areas. As part of the current research being conducted on lead poisoning by the Section of Wetland Ecology of the Patuxent Wildlife Research Center, a study was initiated to determine possible effectiveness of various grit types in alleviating lead poisoning.

Special thanks are extended to Hsin-yuan Tu, Geologist, Soil Survey Laboratory, Soil Conservation Service, U.S. Department of Agriculture, Beltsville, Md., for determining the mineral and chemical composition of grit types. Thanks are also due biologists Harold D. Irby, Louis N. Locke, Robert G. Heath, and John L. Sincock, Patuxent Wildlife Research Center, for their valuable assistance.

MATERIALS AND METHODS

A 60-day test was made using 288 first-year, drake mallards. The ducks were obtained in late July from a breeder in Birdsboro, Pa. Two weeks before initiation of the study, the ducks were wing-clipped (primaries cut off one wing) and placed in 36 pens for conditioning. Pens were 9 x 5 x 2 feet high and provided with a 260-gallon stock-watering tank (Cornwell and Hartung, 1963). Each pen and tank was partitioned into two units to hold eight ducks. Birds were deprived of grit during this conditioning period. Before putting the birds on test, grit removal was attempted on 12 live mallards with a water aspirator (Nord, 1941). This was found impractical and was discontinued.

A 3 x 4 factorial comparison was made of the effects of 3 quantities of No. 6 lead shot per bird (0, 2, and 4) in combination with, (1) no additional grit and the addition of (2) coarse sand, (3) mica granite, and (4) crushed oystershell. The 12 treatments were replicated 3 times and randomly assigned to the 36 pens. Since treatments could not be initiated in all pens at one time, the replicates were "blocked" into 3 time periods, each period being assigned 1 pen of each of the 12 treatments. The replicates were initiated between August 26 and September 13, 1965.

Lead shot were placed in the gizzard using a funnel and small plastic tube. Initially each duck was weighed and leg-banded. Body weights were also recorded at 14-day intervals, at the time of death, and at the end of the test. All ducks were fluoroscoped on the 14th and 28th day after dosing to determine shot retention. Ducks not given lead were fluoroscoped to provide comparable handling.

Cages were flushed with water daily and each tank was drained, cleaned, and refilled every 3 days. Whole corn and the assigned grit were offered ad libitum.

The average daily corn consumption per duck was calculated at intervals for each treatment group by multiplying the number of surviving ducks by the number of days required to nearly empty a feeder. The bird-days for a group were calculated whenever a duck died and the amount of corn consumed was divided by the bird-days to estimate average consumption per bird day.

At the end of the test, surviving ducks were killed and all ducks necropsied. The condition of the gizzard and the number of lead shot retained were recorded.

RESULTS

Mortality

Percent mortality over the 60-day period for all treatment replicates is shown in Table 1. The greatest mortality of ducks given lead shot, regardless of grit type, occurred between 16-20 days after dosing. Within 25 days after dosing, 27 percent of the ducks given 2 shot, and 51 percent of the ducks given 4 shot, succumbed. Only 8 ducks which had been given lead lived beyond the 25th day after dosing.

An analysis of variance of percent mortality for the first 25 days (Table 2) showed no significant difference among grit types. A significant difference in mortality between the 2-shot and 4-shot doses was demonstrated at the 0.05 level of significance. The mean percents of mortality over the first 25 days for 2 and 4 shot treatments, regardless of grit type, were 28 and 53, respectively. Over the 60-day period mean percents of mortality for the 2 and 4 shot treatments were very similar at 35 and 54, respectively.

Body Weight Losses

The percent loss of initial body weight at 14-day intervals over the 60-day test is presented in Table 3. The peak weight losses (up to 24 percent) among all grit treatments and shot doses were recorded during the first 28 days. Ducks which died during the test, however, frequently lost more than 50 percent of their initial body weight.

Weight losses among lead-dosed survivors and those birds not given lead were similar. The consistent weight loss by all birds could have resulted from the inadequacy of the corn diet. Several factors could explain why weight losses among lead-dosed survivors were less than expected: Survivors may have rid themselves of shot early enough to avoid poisoning; they may have been hardier birds initially; or, as mortality progressed, they may have experienced less stress from crowding than did the undosed birds. There was no apparent relationship between mortality and initial body weight.

Shot Retention

The percent of shot retention, as determined by fluoroscopy, for mallards surviving 14 and 28 days after dosing is presented in Table 4. Fourteen days after dosing, 29 percent of those ducks given 2 shot and 54 percent of those ducks given 4 shot had retained at least 1 shot in their gizzards. Twenty-eight days after dosing only one surviving duck (on 2 shot dose) had retained shot.

All ducks on coarse sand which had retained shot at 14 days died before fluoroscopy on the 28th day. However, all ducks which passed their shot before the 14th day survived the 60-day test (Table 5).

Of the ducks given 4 shot, a higher percent of those on oystershell grit retained shot to the 14th day than on other grit types. Paradoxically, ducks on oystershell grit and given 4 shot suffered the lowest percent mortality of the 4 grit treatments.

The number and percent of ducks which retained shot at death for each grit treatment are shown in Table 6. Slightly more than half of the ducks given 2 lead shot and offered coarse sand, mica granite, and oystershell grit retained shot at death.

Bellrose (1959) cited work by Jordan that showed penned, wild mallards which were force fed 1 or more No. 6 shot passed the shot as early as the first week or as late as several weeks after dosing. This was also true in this study.

Food Consumption

The average daily corn consumption per duck for the control ducks (no grit, no shot) during the 60-day test was 0.12 pound. This corresponds closely with Jordan's (1953) study in which wild penned mallards consumed 0.13 pound of corn daily in early fall. Corn consumption by birds for each treatment is shown in Table 7. Average consumption per bird decreased with increased shot dose on all grits except crushed oystershell.

Gizzard Examination

Among birds which died during the test in the same treatment, pathological conditions of the keratinous pads and interpad mucosa of the gizzards varied from a normal yellow color to dark, greenish-brown staining with ulcerations.

The gizzards of the 60-day survivors on crushed oystershell had a characteristic white coating on the inner lining, and the gizzards of the survivors on other grits appeared a normal yellow color without ulcerations.

Ducks not offered additional grit retained considerable grit which had been ingested before they were put on test.

CONCLUSIONS

1. Mortality of lead-dosed mallards varied among treatment replicates. The greatest mortality of ducks on the different grit types and given 2 or 4 shot occurred 16-20 days after dosing. Bellrose (1959) observed that mallards with lead shot still in the gizzard died on the average of 21 days after ingesting it, and that 20 days was the average "turnover" period of leaded mallards in the wild.

2. An analysis of variance indicated no significant differences in mortality in relation to grit types, but a significant difference at the 95 percent level of confidence was demonstrated in mortality between shot dosage levels. The total mortality of ducks given 4 shot was lowest for the group on oystershell grit but the difference was not statistically significant. However, the comparatively lower mortality of lead-dosed ducks given oystershell grit suggests that further studies of a calcium grit might be fruitful.

3. The greatest body weight losses occurred in the first 28 days after dosing among all treatments. Ducks that died which had been given either 2 or 4 lead shot lost an average of 54 percent of their initial body weight. There appeared to be no relation between mortality and initial body weight.

4. Shot retention 2 weeks after dosing as determined by fluoroscopy was greater in the ducks given 4 shot than those given 2 shot. Twenty-eight days after dosing only one surviving duck had retained at least one shot. Although a greater percent of the ducks given crushed oystershell grit and 4 lead shot had at least 1 shot at 14 days. This group of ducks suffered the least mortality among the other grit treatments given 4 lead shot.

5. Gizzards of lead-dosed mallards which died during the test were stained a dark, greenish-brown and had ulcerations.

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Table 1. Mortality (in percent) during a 60-day test among replicated pens of 8 mallards each treated with grit and lead shot.

Treatment	Percent Mortality by Replicates											
	Lead Shot Dosage											
	No Shot				2 Shot				4 Shot			
	A	B	C	Ave.	A	B	C	Ave.	A	B	C	Ave.
No Grit	0	0	0	0	25	38	38	33	25	50	100	58
Coarse Sand	0	13	0	4	50	13	25	29	13	100	75	63
Mica Granite	0	0	0	0	25	38	50	38	65	50	63	58
Crushed Oystershell	0	0	0	0	38	13	75	42	25	38	50	38
Mean				1				35				54

Table 2. Percent mortality for first 25 days among 8 duck replicates given lead shot and various gritty types.

Treatment	Percent Mortality by Replicates							
	Lead Shot Dosage							
	2 Shot				4 Shot			
	A	B	C	Ave.	A	B	C	Ave.
No Grit	25	25	25	25	25	50	88	54
Coarse Sand	50	13	25	29	13	100	75	63
Mica Granite	25	13	50	29	63	50	63	58
Crushed Oystershell	25	0	63	29	25	38	50	38
Mean				28				53

Table 3. Percent loss of initial body weight of survivors at 14 day intervals over 60-day test period.

Treatment	Lead Shot Dosage																	
	No Shot						2 Shot						4 Shot					
	No.	Day					No.	Day					No.	Day				
		14	28	42	56	60		14	28	42	56	60		14	28	42	56	60
Birds	%	Wt.	Loss			Birds	%	Wt.	Loss			Birds	%	Wt.	Loss			
No Grit	24	8	11	12	14	16	16	7	9	9	11	12	10	9	8	6	9	12
Coarse Sand	23	6	9	11	11	12	17	13	12	11	10	10	9	13	13	9	7	6
Mica	24	11	13	11	11	11	15	11	12	13	12	11	10	24	22	18	17	18
Granite																		
Crushed	24	11	12	11	10	10	14	4	6	5	4	4	15	10	10	10	8	8
Oystershell																		

Table 4. Retention of at least 1 shot in the gizzard as revealed by 14 and 28 day post-dosage fluoroscopy.

		Lead Shot Dosage							
		2 Shot				4 Shot			
Treatment	No. Dosed	14 days		28 days		14 days		28 days	
		No. Alive	% with Shot	No. Alive	% with Shot	No. Alive	% with Shot	No. Alive	% with Shot
No Grit	24	23	48	18	6	21	52	11	0
Coarse Sand	24	23	13	20	0	22	50	11	0
Mica	24	24	25	19	0	23	48	12	0
Granite									
Crushed	24	24	29	19	0	24	63	15	0
Oystershell									
Total		94	--	76	-	90	--	49	-
Average		--	29	--	1	--	53	--	0

Table 5. Shot retention (at least 1 shot) by 60-day survivors given 2 or 4 lead shot as determined by 14 and 28 day post-dosage fluoroscopy.

Treatment	Lead Shot Dosage						
	2 Shot				4 Shot		
	No. Dosed	60-day survivors	% with shot 14 day	% with shot 28 day	60-day survivors	% with shot 14 day	% with shot 28 day
No Grit	24	16	25	6	10	10	0
Coarse Sand	24	17	0	0	9	0	0
Mica Granite	24	15	7	0	10	10	0
Crushed Oystershell	24	14	7	0	15	40	0

Table 6. Number of mallards which died during the 60-day test and retained at least 1 lead shot.

Treatment	No. Dosed	Lead Shot Dosage			
		2 Shot		4 Shot	
		No. Died	% with shot	No. Died	% with shot
No Grit	24	8	100	14	93
Coarse Sand	24	7	57	15	87
Mica Granite	24	9	56	14	86
Crushed Oystershell	24	10	60	9	100

Table 7. Food consumption per bird per day (lb.) over 60-day test for mallards given various types of grit and lead shot.

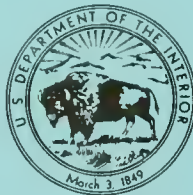
Treatment	Average food intake per bird per day (lb.)		
	Lead Shot Dosage		
	No Shot	2 Shot	4 Shot
No Grit	.12	.10	.08
Coarse Sand	.11	.09	.08
Mica Granite	.10	.10	.09
Crushed Oystershell	.09	.09	.09
Mean	.11	.10	.09

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